

Addressing

Addressing Issues

- Types of data that can be addressed
- Addressing modes

Data Types

- Hardware support is needed for the data types referenced by an instruction.
- Data types that need to be supported
 - Numeric:
 - integers (signed and unsigned) with lengths short (16 bit) or long (32 bit)
 - floating point with lengths of 32, 64 and 128 bits
 - Non-numeric:
 - mainly strings

Addressing Modes (I)

- Specify how an operand is accessed
 - E.g., constant, a register, or a memory location
 - Some types of addressing modes
 - Immediate
 - Base / Indexed
 - Direct
 - Register
 - PC-relative
 - Indirect
- MIPS** - Load and store only instructions access memory

Addressing Modes (II)

- Immediate
 - The operand contains the value of the datum.
 - Eg: **add \$r4, \$r2, #5**
 $\$r4 = \text{Data in register } \$r2 + 5$
- Direct (pseudo-direct for MIPS)
 - The operand contains the memory address of the datum.
 - Eg: **add \$r4, \$r2, (1024)**
 $\$r4 = \text{Data in register } \$r2 + \text{Data at memory address } 1024$
- Register
 - The operand contains the register designation where the datum is located.
 - Eg: **add \$r4, \$r2, r3**
 $\$r4 = \text{Data in register } \$r2 + \text{Data in register } \$r3$

Addressing Modes (III)

- PC-relative

- The operand contains the offset from the PC

- Eg: **beg \$r1, \$r2, 25**

If ($\$r1 = \$r2$) go to PC = PC + offset (25)

PC – Program Counter

- base / Indexed

- A register contains a base address and an operand holds a displacement from this base

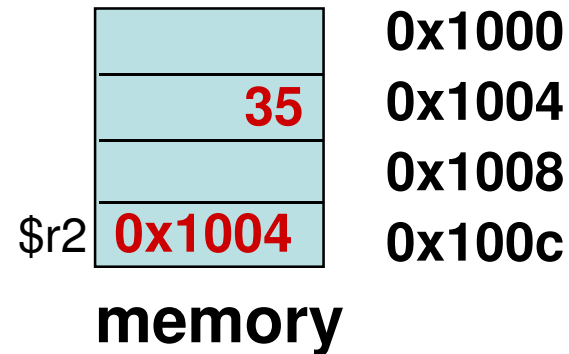
Note: the base register may be another operand or implicit

- Eg: **lw \$r1, 100(\$r2)**

$r1 = \text{Memory}(r2 + 100)$

Addressing Modes (IV)

- Indirect
 - The operand contains the (memory) address of the datum
 - E.g: **LD \$r3, (\$r2)**
\$r3 = Contents of memory address in register \$r2

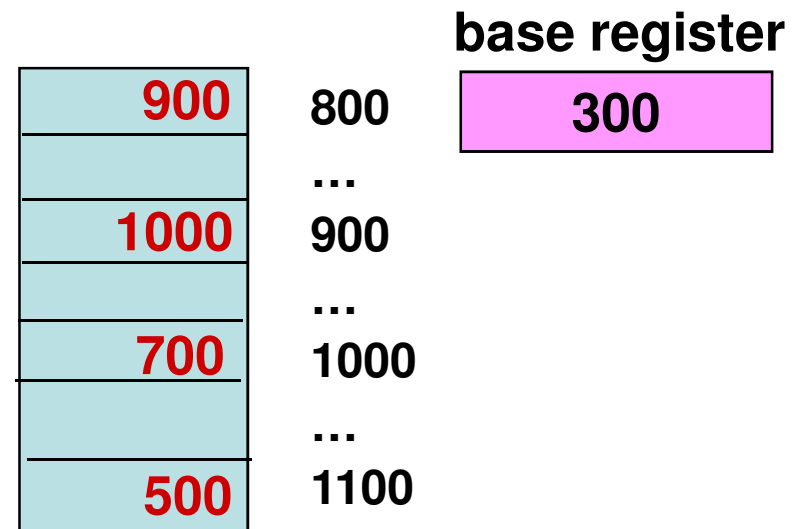


Addressing Modes – Example

Consider the instruction `LOAD $R1, 800`

Which value is loaded into register `$R1` for each addressing mode?

- Immediate
- Direct
- Base
- Indirect



Addressing Modes – Answers

- Immediate - 800
- Direct – 900 (800 contains the intended value)
- Base - 500 (800 is added to the content of the base register = 300, which gives 1100, and the content of word 1100 is retrieved)
- Indirect– 1000 (800 has the memory address 900, and memory address 900 contains the value)

